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# PULP & PAPER

November 1984

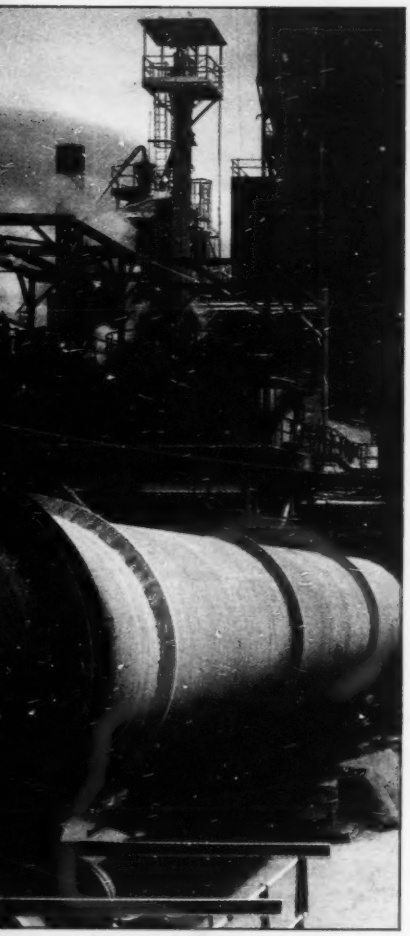
COVER STORY: MacMillan Bloedel converts lime kiln to burn gasified hog fuel

PULPING: Working on the bottom

CHEMICAL SURVEY: Availability, prices of major chemicals used in the industry

# PULP & PAPER

Volume 58 Number 11 November 1984

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***COVER:*** *MacMillan Bloedel cuts lime kiln fuel oil use 50% by converting to gasified wastewood (see page 140). (Photo courtesy of Lamb-Cargate.)*


## PULPING

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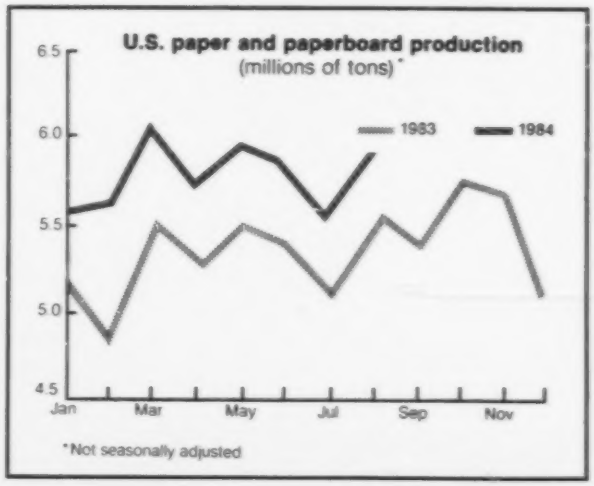
# MONTH IN STATISTICS

**U.S. paper and paperboard** production showed little increase from a year ago, but the August 69.4-million-tpy moving average of seasonally adjusted data held close to the July average of 69.6 million tpy, according to the American Paper Institute. There are indications that the demand for paper and some grades of paperboard is easing from the torrid pace set in the earlier months of the year.

**Among the major grades,** early indicators are signaling caution within the printing paper grade sector as new orders for uncoated free sheet have been below shipment levels since March. Paperboard production is up 8.1% over last August, lagging behind the year-to-date comparison of 9.4%. Corrugated box shipments were 4.7% ahead of August 1983, a little slower pace than the 8.4% increase shown in the comparison of year to date figures. Imports in July, reflecting a strong U.S. dollar, were up 48% over July 1983.

**Canadian newsprint shipments** totaled 752,000 metric tons in August, up 8.0% from August 1983, according to the Canadian Pulp & Paper Assn. Newsprint mill operating rates stood at 94% in August compared with 86% last year.




| | | Latest month (000 short tons) | % change from year ago | Annualized year-to-date (000 short tons) | % change from year ago |
|---|---|---|---|---|---|
| **PAPER & PAPERBOARD** | | | | | |
| Newsprint | August | 470 | 2.6 | 5,585 | 8.3 |
| Uncoated groundwood (s) | August | 118 | −8.5 | 1,578 | 6.0 |
| Coated paper (s) | August | 528 | 5.0 | 6,193 | 12.1 |
| Uncoated free sheet (s) | August | 749 | −0.9 | 9,227 | 6.4 |
| Unbleached kraft packaging and industrial (s) | August | 318 | −9.4 | 3,918 | 4.4 |
| Tissue | August | 432 | 10.8 | 4,911 | 3.0 |
| **Total paper** | **August** | **2,896** | **0.8** | **34,858** | **7.2** |
| Kraft linerboard, unbleached | August | 1,427 | 9.3 | 16,278 | 9.7 |
| Semichemical medium | August | 449 | 10.6 | 5,225 | 12.0 |
| Bleached paperboard | August | 352 | 7.6 | 4,130 | 4.9 |
| Recycled paperboard | August | 641 | 3.4 | 8,031 | 10.0 |
| **Total paperboard** | **August** | **2,970** | **8.1** | **34,875** | **9.4** |
| **Total paper and paperboard*** | **August** | **5,866** | **4.4** | **69,733** | **8.3** |
| **PULP & WOOD** | | | | | |
| Total woodpulp production | July | 4,525 | 10.0 | 55,856 | 7.8 |
| Market pulp production | July | 570 | 15.2 | 6,763 | 5.5 |
| Wastepaper consumption at paper/board mills | July | 1,219 | 8.1 | 15,802 | 10.4 |
| Pulpwood consumption (cords) | July | 7,192 | 5.7 | 88,078 | 4.2 |
| **BOXES** | | | | | |
| Corrugated box shipments (billion ft²) | August | 23.759 | 4.7 | 180.067† | 8.4 |
| Containerboard inventories at box plants | August 1 | 2,767 | 11.3 | | |
| **FOREIGN TRADE** | | | | | |
| U.S. paper imports (including products) | July | 1,039 | 48.0 | 10,977 | 27.7 |
| Imports of Canadian newsprint | July | 695 | 29.9 | 7,595† | 13.8 |
| U.S. paper exports (including products) | July | 376 | −9.6 | 4,557 | −1.2 |
| Exports of unbleached kraft linerboard | August | 215 | 13.2 | 2,151 | −8.3 |
| Exports of woodpulp | July | 279 | 7.7 | 3,637 | 2.2 |
| **CANADIAN STATISTICS** | | | | | |
| Total newsprint shipments | August | 752 | 8.0 | 5,952† | 9.2 |
| Operating rates | August | 94% | 86% | 91% | 83% |
| Inventories held by U.S. consumers | August | 938 | 4.6 | | |
| Woodpulp shipments (export only) | August | 618 | −0.8 | 4,363† | −0.6 |
| Operating rates | August | 94% | 86% | 91% | 83% |

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fiber Box Assn., Paperboard Packaging Council. 4. Canadian Pulp & Paper Assn.
*Includes construction and wet machine grades. †Not annualized. ‡Not directly comparable to year ago because of coding change. (s) = shipments.

# **Unbleached kraft paper:** High operating rates but no growth

| Statistics | 1982 | 1983 | 1984e |
|---|---|---|---|
| Production, 000 tons | 3,688 | 3,807 | 4,015 |
| Capacity, 000 tons[1] | 4,091 | 4,001 | 3,911 |
| Utilization rate, % | 90.1 | 95.2 | 97.4 |
| Imports, 000 tons[2] | 23 | 42 | 54 |
| Exports, 000 tons[3] | 89 | 116 | 104 |
| Apparent U.S. consumption | | | |
| 000 tons | 3,622 | 3,733 | 3,965 |
| lb/capita | 31.2 | 31.9 | 33.5 |
| 000 tons/$ billion real GNP (1972) | 2.45 | 2.43 | 2.43 |

1. American Paper Institute (shipments). 2. American Paper Institute capacity survey (1983). 3. Commerce Dept. e = *Pulp & Paper* estimate.

**GRADE STRUCTURE:** Unbleached kraft paper (UKP) is normally divided into four end-uses: wrapping, bag and sack, shipping sack, and other converting. Bag and sack paper is the largest category, accounting for about 59% of total shipments, followed by multiwall shipping sack, 24%; other converting, 14%; and wrapping, 3%.

Basis weights for bag and sack paper range from 30 lb to 80 lb/3,000 ft², with the lower basis weights used for small grocery and merchandise bags and 70 lb most commonly used for grocery carryout sacks. Multiwall shipping sack paper is usually 50 lb or 60 lb. Extensible or air-dried paper may be used for shipping sacks and other bags requiring greater strength and toughness.

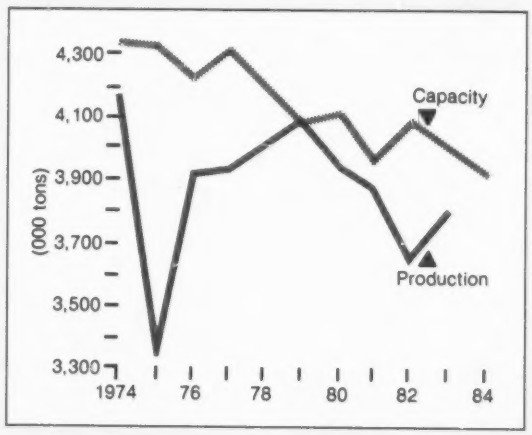
**PRODUCTION/CAPACITY:** UKP shipments have been coming back after reaching a low of 3.7 million tons in the 1982 recession year. Shipments this year should rise about 5.5% to 4.0 million tons, almost back to the prerecession peak of 4.1 million tons in 1979. Because of a slight decline in capacity, operating rates this year will average 97.4% vs 95.2% in 1983, and 90.1% in 1982.

Unbleached kraft bag and sack shipments have been remaining stable at about 2.2 million tons despite competition from plastic grocery carryout sacks, which last year captured about 5% of the U.S. market, according to the American Paper Institute. Multiwall shipping sack paper has shown some improvement this year after dropping to around 880,000 tons in 1982-83 due to the recession and the federal government's Payment-In-Kind program, which depressed agricultural demand.

**OUTLOOK:** Production of UKP will probably show a declining trend over the next several years due to competition from plastics, although operating rates should remain high due to conversion of machines to linerboard and white paper.

Some forecasters have predicted that plastic sacks will capture as much as 25% of the grocery carryout sack market over the next several years. If true, this could result in a production loss of roughly 380,000 tons. However, inroads from plastic sacks so far have been proceeding more slowly than expected, perhaps because of higher labor costs for bagging at supermarkets.

According to the 1983 API capacity survey, UKP capacity is expected to decline by 247,000 tons between 1982 and 1986. This would cause capacity to drop to 3.84 million tons in 1986. Since then, several other capacity withdrawals have been announced. Georgia-Pacific is phasing out 120,000 tpy of UKP capacity at its Crossett, Ark., mill in 1984 and may phase out another 280,000 tpy by converting a machine at its Monticello, Miss., mill to linerboard in late 1985. International Paper is converting a 135,000-tpy machine at its Mobile, Ala., mill to white paper in early 1985.




| Estimated capacities of major U.S. companies | Annual capacity (000 short tpy) | Capacity share (%) |
|---|---|---|
| 1. St. Regis | 550 | 14.1 |
| 2. Georgia-Pacific | 536 | 13.7 |
| 3. Stone Container | 494 | 12.6 |
| 4. Union Camp | 425 | 10.9 |
| 5. Longview Fibre | 320 | 8.1 |
| 6. International Paper | 260 | 6.6 |
| 7. Gilman Paper | 205 | 5.2 |
| 8. Champion | 160 | 4.1 |
| 9. Westvaco | 150 | 3.8 |
| 10. Chesapeake | 115 | 2.9 |

**U.S. capacity (1984):** 3.911 million tons
**Capacity share of top five companies:** 59.4
**Capacity share of top ten companies:** 82.2

**PRICING:** UKP pricing, particularly for heavyweight grocery sack paper grades, was under severe pressure during the recession. This was due to excess linerboard production being swung into the kraft paper market. There is an estimated 1.0 million tons of such swing capacity in the industry. Since the second half of 1983, however, kraft paper prices have been coming back strongly, helped by the firming linerboard market.

Year-end price history for 70-lb grocery sack is as follows: 1978, $240; 1979, $260; 1980, $280; 1981, $300; 1982, $240; 1983, $280; mid-1984, $360 (with discounting). Multiwall sack kraft (50-lb): 1978, $305; 1979, $340; 1980, $375; 1981, $405; 1982, $360; 1983, $380/$410; 1984, midyear $440 (with discounting).



(News section continues on page 23)

## Rock-Tenn buys Stroudsburg mill

Rock-Tenn Co. became "the largest privately owned paperboard and packaging producer" with the Sept. 28 purchase of Stroudsburg Paperboard Co.'s 40,000-tpy recycled clay-coated board mill in Stroudsburg, Pa., the company said.

The Stroudsburg mill, bought last July from Packaging Corp. of America by a group of investors headed by Chuck Dufon of Toronto Paperboard Co. (*P&P*, Sept. 1983, p. 33), is the fourth in Rock-Tenn's mill division. Other mills include the 47,000-tpy Eaton, Ind., 100,000-tpy Chattanooga, Tenn., and 126,000-tpy Dallas, Texas, recycled paperboard mills.

Rock-Tenn, a privately held company, owns a total of 47 paper and board manufacturing and distributing facilities across the country, according to a Rock-Tenn announcement. Its entry into the primary industry began with the purchase of the Dallas mill from Clevepak Corp. in 1979. The Eaton mill and several converting facilities now owned by Rock-Tenn were also bought from Clevepak, the sale occurring last August (Aug. 1983, p. 25). At the time, Clevepak was divesting its assets to pay off debt.

One industry observer felt Rock-Tenn would switch the Stroudsburg mill from clay-coated to chipboard to supply its seven fiber partition plants and its filler board facilities, but another observer said the company would continue to produce folding carton board at the mill. The company said it would announce plans for the mill later.

## O-I issues stock poison pill

Acting to block a possible unfriendly takeover, Owens-Illinois Inc. in September approved a special issue of preferred stock designed to make the company too expensive to any potential acquirers, an O-I spokesman said.

In early September, O-I's stock jumped sharply in heavy trading due to rumors that an unknown buyer was amassing the company's common stock in preparation for a takeover (*P&P*, Oct., p. 27). Sir James Goldsmith, who earlier made unsuccessful attempts to acquire St. Regis Corp. and Continental Group Inc., was the most popular suspect.

**Correction:** September's Grade Profile inadvertently contained statistics for uncoated free sheet, not uncoated groundwood paper. The correct figures for uncoated groundwood are given below.

| Statistics | 1982 | 1983 | 1984e |
|---|---|---|---|
| Production, 000 tons | 1,471 | 1,531 | 1,610 |
| Capacity, 000 tons[1] | 1,749 | 1,755 | 1,733 |
| Utilization rate, % | 84.1 | 87.2 | 92.9 |
| Imports, 000 tons | 653 | 920 | 950 |
| Exports, 000 tons | 56 | 38 | 30 |
| Apparent U.S. consumption | | | |
| 000 tons | 2,068 | 2,413 | 2,530 |
| lb/capita | 17.89 | 20.68 | 21.49 |
| 000 tons/$ billion real GNP (1972) | 1.39 | 1.57 | 1.58 |

e = Estimated.
1. *Pulp & Paper* estimate.

## Champion, St. Regis merger set for vote

The holding period for the Champion International Corp. and St. Regis Corp. merger expired on Oct. 8 without any word from the Federal Trade Commission objecting to the merger that would create the nation's largest paper company and the second largest producer of lumber and timber. The holding period, originally set to expire on Sept. 17, was extended to allow the FTC to further investigate the merger. During the period, Champion agreed not to exercise control over St. Regis.

In the next step of the merger process, stockholders of both companies are to vote on the $1.84-billion transaction. A Champion spokesman said the companies are working to have the merger take place before the end of 1984.

Champion was served with an FTC subpoena in late September for employee testimony and other information regarding the printing and writing paper businesses of both companies as part of the FTC investigation of Champion's purchase of St. Regis. Both companies produce coated paper, and industry analysts say that together they account for 16% to 17% of total U.S. coated paper capacity. However, each company produces different types of coated paper for different markets. All of Champion's capacity (365,000 tpy) is in higher quality coated free sheet used in commercial printing, while St. Regis makes only coated groundwood paper (625,000 tpy) for magazines and catalogs. Therefore, Champion did not believe that combination of their coated paper operations would violate U.S. antitrust law.

Another area of antitrust concern to the FTC was linerboard. As part of an August agreement with the FTC (*P&P*, Oct., p. 27), Champion agreed to keep St. Regis's 250,000-tpy Tacoma, Wash., linerboard and kraft paper mill separate from its operations but was allowed to make complete its tender offer for St. Regis. Champion also makes linerboard at its 375,000-tpy Missoula, Mont., mill.

Champion said earlier in September that it would carry out a St. Regis agreement to buy 22% of Colonial Penn Group Inc., but that it wouldn't acquire the rest of the Philadelphia insurance company. St. Regis already owned a 9.9% interest in Colonial, which will transfer to Champion once their merger is completed, leaving 12.1% to be acquired by Champion.

St. Regis agreed to buy Colonial in June for about $590 million in a defensive strategy which some analysts say was aimed at stopping an unfriendly takeover attempt by Rupert Murdoch (Sept., p. 27). At that time, St. Regis bought a 9.9% share of Colonial for $14.1 million plus $43 million in St. Regis convertible adjustable preferred stock.

In an agreement among Champion, St. Regis and Colonial, St. Regis will buy back, when it merges with Champion, the 860,260 St. Regis preferred shares which Colonial received for the 9.9% stake.

Terms of the original agreement between St. Regis and Colonial have been modified, and the purchase by Champion of the additional 12.1% interest in Colonial with $85.6 million of Champion stock isn't likely to occur until May or June 1986, unless Colonial is acquired before then. St. Regis agreed to pay Colonial $1.5 million for expenses related to the terminated agreement.

TECHNOLOGY

## New paper process begins production

Glassper International Inc. of Memphis, Tenn., has started up a production line to demonstrate commercially its new process for chemically reinforcing paper. In development for three years, the Glassper process involves saturating a sheet with water-based, high-solids chemicals to improve strength and flame retardation (*P&P*, July 1983, p. 29).

Products include a self-extinguishing, strengthened paper called Thermo-Max, and Hard Core treatment to strengthen tubes and cores. Hard Core production is now underway with Gartex and Merkor stock from Yorktowne Paper Mills. Automotive, construction and industrial packaging applications are being investigated, as well as possible products in the decorative panel field. Licensing of technology is also available.

Ring crush tests on four brands of cores in basis weights from 80 to 102 lb showed strength improvements between 150% and 300%, the company said. Treated 60-lb low-density linerboard with 50% added solids was over four times as strong as an untreated sheet, the tests showed. Similar tests on 42-lb liner and 26-lb medium produced gains ranging from 70% to almost 500%, depending on the percentage of added solids.

Production capacity is currently limited to 50-in. roll widths, although this is being expanded to 60 in. A three-meter machine for a European company is being negotiated.

CHEMICALS

## G-P to sell off commodity chemicals

Georgia-Pacific Corp. announced at the begining of October that it will sell some of its commodity chemical operations to a group of executives who currently manage them. James R. Kuse, senior vice president for chemicals at G-P, will head Georgia Gulf Corp., the new firm.

The commodity-chemical assets to be sold include the large Plaquemine, La., chemical complex, a cumene plant near Houston, a phenol plant in New Jersey and several polyvinyl chloride compounding plants. G-P had studied its chemical operations earlier this year and decided to retain the chemical lines related to its forest products businesses.

G-P also said it is continuing to evaluate bids for Exchange Oil & Gas, its New Orleans, La.-based oil and gas subsidiary, which it had earlier announced plans to sell. It is expected that the sale of Exchange and the chemical operations will result in financial writeoffs.

## Anthraquinone plant closed

Schelde Chemie, a West Germany joint venture, will permanently close its 10,000-tpy Brunsbuettel anthraquinone plant because of technical problems with the new process it uses and because of a market decline for anthraquinone. The plant exploded while in the startup phase in 1983. To date, the company had spent $92 million on the process.

CAPITAL SPENDING

## U.S. capital spending forecast lowered

U.S. pulp and paper companies will spend slightly less in 1984 on new plant and equipment than previously expected, but Canadian producers have lifted their sights substantially, according to two recent government surveys.

The latest Commerce Dept. survey of capital spending plans, conducted in July and August, found that U.S. pulp and paper companies planned to spend a record $7.13 billion for new plant and equipment in 1984, up 15.4% from $6.18 billion in 1983. The last survey, conducted in April and May, showed that spending would climb 16.0% to $7.17 billion.

On a seasonally adjusted annual basis, paper industry spending rose to $7.05 billion in the second quarter from $6.93 billion in the first, and outlays are expected to keep climbing. Companies planned to increase spending to $7.25 billion in the third quarter and $7.28 billion in the fourth.

Overall, U.S. business plans a 14.3% increase in 1984 capital spending compared to 1983, down from the 14.8% rise shown in the last survey. Real spending—after adjustment for inflation—will rise 13.3%, Commerce estimates.

**Big Canadian increase.** Although they have a long way to go before matching prerecession spending levels, Canadian producers seem to be headed in the right direction. Canadian paper and allied products companies now plan capital expenditures of C$1.27 billion in 1984, up 19.8% from $1.06 billion in 1983, according to Statistics Canada's mid-year review. An earlier survey, completed in February, showed an 1984 increase of only 2.8% over 1983, to $1.09 billion.

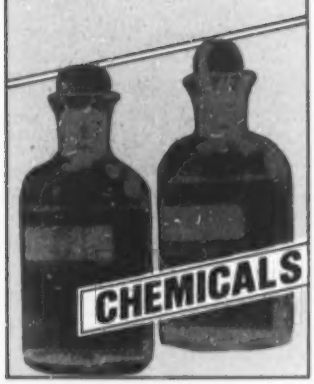
The biggest turnaround is in construction outlays. Companies now plan to boost construction expenditures 15.6% in 1984 to $151.5 million, compared with a projected decline of 16.6% shown in the earlier survey. Spending for new machinery and equipment is expected to rise 20.4% from last year, to $1.12 billion, compared with an increase of only 5.2% shown in the earlier survey. Construction now accounts for 12% of the planned capital expenditures, while 88% is earmarked for new machinery and equipment.

By province, capital outlays are expected to climb 23.9% to $526.9 million in Quebec, 21.2% to $308.9 million in Ontario, and 105.9% to $243.2 million in British Columbia. The British Columbia figure represents a major revision from the last survey, when spending was seen rising only 7.4% to $126.8 million. The revised figure of $243.2 million is still well off the 1982 pace of $366.1 million, however.

*TABLE 1:* **1984 capital spending in the U.S. and Canada.**

| | U.S. (Billion $) | Canada (Billion C$) |
|---|---|---|
| 1984 totals[1] | 7.13 | 1.27 |
| 1983 totals | 6.18 | 1.06 |
| Quarterly spending[2] | | |
| 1984 4th quarter[1] | 7.28 | n.a. |
| 3rd quarter[1] | 7.25 | n.a. |
| 2nd quarter | 7.05 | 1.27 |
| 1st quarter | 6.93 | 1.09 |

[1]Estimated. [2]Seasonally adjusted annual basis.




# Pulp/paper chemical use, prices continue to strengthen in 1984-85

## *Pulp & Paper*'s annual chemical survey forecasts good availability with prices firming up as paper industry continues on the road to recovery

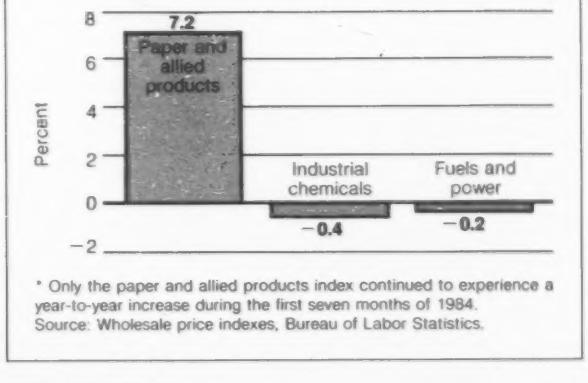
**By BARRY SHOCKETT**

■ Buoyed by the continued recovery of the U.S. pulp and paper industry in 1984, chemical selling prices have been firming as demand continued to increase for most products. Although discounting has continued in some cases, it is well below the level prevailing in 1983. The year-to-year wholesale price index for July 1984 (Figure 1) was down marginally—considerably less than the 3% reported in July 1983. Similarly, the fuels and power index was off slightly to 667.2 from the revised 668.7 for last year's seventh month. (In March, the index was up 0.1%, while in June it was 0.4% ahead of last year.) The chemical index, on the other hand, rose 1.7% in March and 2.1% in June. Projected price increases for some of the major chemicals in 1985 range from 5% to 15% (Figure 2); the price hikes for the organic products are at the low end of the range.

Coated paper output was running 14.5% ahead of 1983 at the seven-month mark in 1984, ensuring increased demand for various coating materials such as titanium dioxide (9%), kaolin (8%), styrene-butadiene latex (5.5%), and starch (3.5%). By August's end, paper and board output were up 8.1% and 8.8%, respectively.

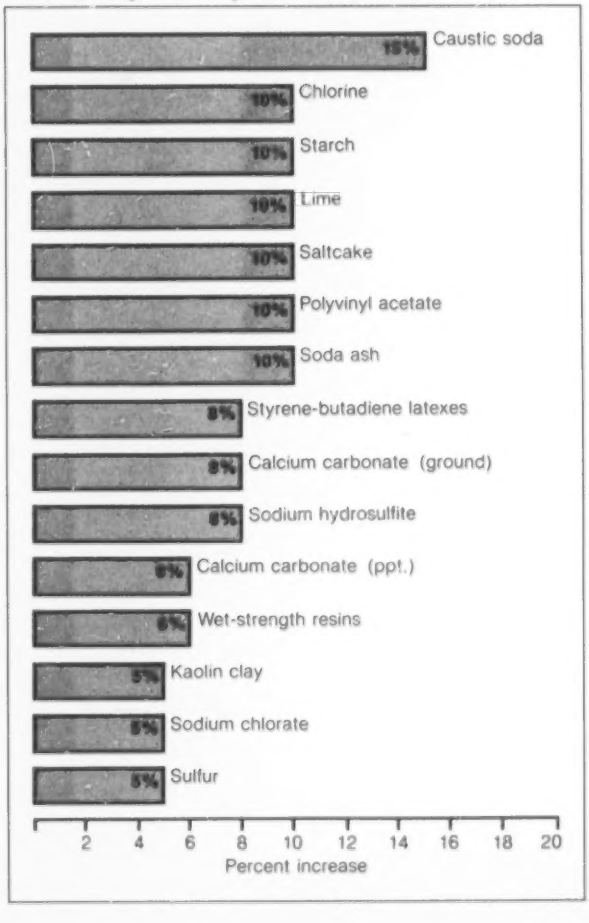
At the end of July 1984, total woodpulp production was almost 8% ahead of last year, while output of market pulp during the first seven months of this year was about 5% greater than a year ago. Thus, one can expect

*FIGURE 1:* **U.S. price index increases for 1984*.**




* Only the paper and allied products index continued to experience a year-to-year increase during the first seven months of 1984.
Source: Wholesale price indexes, Bureau of Labor Statistics.

*FIGURE 2:* **Projected U.S. price increases for chemicals in 1985.**

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increases in 1984 mill demand for the larger-volume chemicals such as sodium chlorate (3%), soda ash (10%), chlorine (7.7%), and caustic (11%).

The chloralkali supply/demand situation has almost returned to the scenario prevailing in early 1982 (caustic tight, chlorine long). In 1983, increased chlorine demand led to a caustic surplus (and subsequent heavy discounting). However, in 1984, increased caustic demand has resulted in significant reductions in plant inventories, while chlorine demand weakened slightly in midyear as housing starts faltered. Still, chlorine output was up 14% over 1983, based on six-month figures.

The Chlorine Institute reported that operating rates in June had risen about 5.5% to 82.3% (from 78% in May), and were significantly higher than the 67.6% rate in the comparable month a year ago. However, excluding mothballed plants, actual operating levels were reportedly more than 85%. Some of the major producers have announced plans to incorporate membrane technology to increase productivity and reduce energy costs.

A major reason for the increased caustic demand in 1984 (up about 11%) has been the continued growth in exports. By the end of July, 762,000 tons had been exported. On an annualized basis, 1984 shipments could reach 1.3 million tons, about 27% ahead of the approximate 1 million tons exported in 1983.

As was the case with caustic, sulfur supply also tightened up in 1984 as the fertilizer industry experienced a strong resurgence. Frasch mine output rose almost 23% in the January to July period, while recovered sulfur production was up 10%. Total elemental sulfur output was up 17% to 5.3 million metric tons. In addition, end-July inventories were down 13% from year-end 1983. ■

**DEFINITIONS OF SURVEY AVAILABILITY TERMS:**

**Very tight**—On allocation, or demand significantly greater than supply.
**Tight**—Demand slightly greater than supply.
**Market**—Supply/demand in balance or excess capacity available.

# CHEMICAL SURVEY: U.S.

## Calcium carbonate

**Uses:** About 85% of the calcium carbonate ($CaCO_3$) used in the paper industry is for coating, with the balance employed as filler. Precipitated grades are used in about 70% of the applications, but ground natural carbonate continues to find increased usage as finer grades are introduced.

**Demand:** In 1983, the paper industry consumed an estimated 154,000 tons of $CaCO_3$. With industry output up more than 8% for the first seven months of 1984, carbonate consumption by the mills should rise this year to approximately 166,000 tons. Other major end-uses include plastics, coatings, and refractories.

**Sources:** Producers are listed in *P&P Buyers Guide 1982*, "Register of coating and filler pigments" (p. 32).

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

**Pricing:** Precipitated: 1984, $180-$191/ton, bulk, f.o.b. works; 1983, $170-$180/ton; 1982, $160-$170/ton; 1981, $95-$160/ton; 1980, $105-$135/ton; 1979, $98-$123/ton. Medium-ground (15-micron): 1984, $116-$124.50/ton, bags, truckload, f.o.b. works; 1983, $108-$116/ton; 1982, $105-$108/ton; 1981, $95-$100/ton; 1980, $90-$95/ton; 1979, $82-$83/ton.

**Forecast:** Precipitated carbonate prices rose about 6% in 1984 and should experience a similar boost next year. Medium-ground $CaCO_3$, on the other hand, increased about 8% in price and is expected to go up between 7% and 8% in 1985.

## Caustic soda

**Uses:** Most of the caustic soda (sodium hydroxide) consumed by the pulp and paper industry is used by kraft and bleached sulfite mills mainly for caustic extraction in the bleach plant. Kraft and semichemical (NSSC) mills also employ some caustic for sodium oxide makeup.

**Demand:** Pulp mills in 1983 consumed an estimated 1.8 million tons of sodium hydroxide, between 17% and 18% of the 10.2 million tons produced. Mill consumption in 1984 is predicted to be up about 11% to 2 million tons, as total caustic production this year is forecast at about 11.6 million tons. Organic and inorganic chemicals together used more than 50% of the total; textiles and aluminum processing each accounted for about 6%.

**Sources:** Caustic soda is a coproduct of chlorine production. See the chlorine profile for major producers.

**Availability:** 1984, market; 1983, market; 1982, tight to market; 1981, very tight to tight; 1980, very tight; 1979, market.

**Pricing:** 1984, $150-$185/ton, 50% solution, f.o.b. works, freight equalized; 1983, $240-$150/ton, 1982, $315-$285/ton; 1981, $270-$320/ton; 1980, $167-$200/ton; 1979, $130-$160/ton; 1978, $160-$170/ton.

**Forecast:** An attempt was made at the beginning of the year to reverse the downward trend in caustic pricing when one or two producers announced a $10/ton boost on off-schedule prices. However, the increase was withdrawn when most of the industry failed to follow suit. A similar move was made in June and this time the $10/ton hike held. This was followed in August by an industry-wide increase of $25/ton, bringing the Gulf Coast tags to $185/ton. The June boost was the first caustic price hike in almost 30 months. In addition to the success of the summer price moves, the reduction in producers' caustic inventories to reasonable levels was announced. This should spur demand and facilitate further price boosts. Off-list tags are expected to go up another 15% in early 1985.

## Chlorine

**Uses:** The major end-use for chlorine in the pulp and paper industry is as a bleaching agent in both kraft and sulfite pulp mills. Small quantities of chlorine are also employed for onsite manufacture of calcium or sodium hypochlorite used to bleach chemical or mechanical pulps.

**Demand:** In 1983, chlorine demand by the pulp and paper industry was an estimated 1.3 million tons—about 13% of the total demand of 10.1 million tons. In 1984, mill consumption is expected to be about 1.4 million tons. Other major end-uses include ethylene dichloride (EDC)—the intermediate for vinyl chloride monomer (VCM) manufacture—inorganic and organic chemicals, and municipal and industrial water treatment. EDC accounts for about 22% of the total.

**Sources:** Approximately 25 companies in the U.S. make chlorine and caustic together by the electrolytic reduction of brine. (Relatively small quantities of chlorine are also produced by oxidation or electrolysis of hydrochloric acid.) The major chloralkali producers (in decreasing order of nameplate capacity) include Dow Chemical, PPG Industries, Diamond Shamrock, Olin, Occidental Chemicals, Vulcan Materials, Georgia-Pacific, Convent Chemical, and Pennwalt. Dow's Midland unit, idled since mid-1982, has been written off. Two

or three other producers have closed uneconomical plants, while several majors are involved in upgrading their facilities to membrane-cell technology.

**Availability:** 1984, tight to market; 1983, market to tight; 1982, market; 1981, market; 1980, market; 1979, tight to very tight.

**Pricing:** 1984, $175-$200/ton, f.o.b. works, freight equalized; 1983, $145-$175/ton; 1982, $145/ton; 1981, $145/ton; 1980, $145/ton; 1979, $135-$150/ton; 1978, $135-$145/ton.

**Forecast:** As anticipated last year (*P&P*, Nov. 1983, p. 76), chlorine prices continued to rise in 1984, but to a lesser extent than was the case in the 1982-83 period. A $15/ton hike at year-end 1983 (effective for contract customers on Jan. 1) was followed by another $25/ton boost at the end of the first quarter. There were no further changes to chlorine tags during the summer and early fall. The continuing growth in chlorine demand early this year was partly responsible for the increases. Another reason was the desire by the chloralkali producers to maintain the ECU value, which had continued to fall as caustic prices (q.v.) remained depressed in early 1984. Although chlorine demand slowed somewhat in midyear, there may be another price hike (about 10%) between now and the first quarter in 1985. Although over the long term chlorine usage by pulp mills will decrease gradually under pressure of continued $ClO_2$ substitution, demand in 1985 is expected to return to the 1980 consumption level of 1.5 million tons.

## Hydrogen peroxide

**Uses:** Hydrogen peroxide ($H_2O_2$) is traditionally used in the pulp and paper industry primarily as a bleaching agent for chemical and mechanical pulps. It is also employed in the deinking of recycled newsprint.

**Demand:** In 1983, the pulp and paper industry used an estimated 15,500 tons, about 13.5% of total consumption (115,000 tons). Peroxide's major end-use is as a chemical intermediate, accounting for between 25% and 30% of total demand. Other applications include textiles, municipal water and waste treatment, industrial effluent treatment, and uranium mining.

**Sources:** The three U.S. $H_2O_2$ producers, in descending order of capacity, are FMC Corp., E.I. DuPont, and Interox America. FMC Corp. is expanding its Bayport, Texas, facility by 10,000 tpy. The expansion is slated for completion by year-end. This will increase industry capacity to 189,000 tons in 1985.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market.

**Pricing:** 1984, 43¢-45¢/lb, 70% solution, f.o.b. works, freight equalized; 1983, 43¢/lb; 1982, 39.5¢/lb; 1981, 35.6¢-39.5¢/lb; 1980, 35.5¢-36.5¢/lb; 1979, 32.5¢/lb; 1978, 28¢/lb.

**Forecast:** Pulp and paper industry consumption in 1984 should reach 17,000 tons (up about 9.5%), while estimated apparent consumption rises to 129,000 tons (up 12%). Increased $H_2O_2$ usage by kraft mills (in the E-2 stage) and continued growth in mechanical pulping should result in an average annual growth in industry demand of 9% to 10% over the next few years. The 2¢/lb boost in peroxide tags on July 1 came 18 months after the previous hike. The next increase (about 5%) should occur in mid-1985.

## Kaolin clay

**Uses:** Kaolin clays are employed in a wide range of paper and board grades as both filler and coating pigment. Coating applications account for about 54% of industry usage.

**Demand:** In 1983, an estimated 3.1 million tons of kaolin were used by the paper industry—about 75% of total kaolin consumption. In 1984, mill usage is expected to rise about 250,000 tons to some 3.3 million tons. Approximate usage by grades: Nos. 1 and 2, 24%; water-washed, 22%; Nos. 3 and 4, 16%; delaminated, 13%; high-brightness and air-float, 10% each; and other, 5%. The next largest end-use is by the ceramics industry (20%) with the remaining 6% accounted for by paints, rubber, refractories, etc.

**Sources:** Producers are listed in *P&P Buyers Guide 1982*, "Register of coating and filler pigments" (p. 32).

**Availability:** 1984, market; 1983, market; 1982, market; 1980, market; 1979, market to tight.

**Pricing:** Premium No. 1 coating: 1984, $165/ton, f.o.b. Georgia; 1983, $155/ton; 1982, $142/ton; 1981, $130/ton; 1980, $84/ton; 1979, $108/ton. Water-washed, No. 1 coating: 1984, $114/ton (same basis); 1983, $108.65/ton; 1982, $99.50/ton; 1981, $91.50/ton; 1980, $84/ton; 1979, $76/ton. Dry-ground, filler grade: 1984, $64/ton (same basis); 1983, $61/ton; 1982, $61/ton; 1981, $56/ton; 1980, $51/ton; 1979, $35-$44/ton.

**Forecast:** Kaolin usage has continued to grow this year as paper and paperboard output was up about 9% by the end of July (compared with the same seven-month period in 1983). Continued growth of the industry in 1985 could result in another 200,000- to 300,000-ton boost in consumption next year.

## Lime

**Uses:** The kraft mill operator requires a low-cost alkali to causticize the sodium carbonate in the green liquor. Lime is the cheapest alkali available (between 2¢ and 3¢/lb), and therefore is basic to the soda/lime route to free caustic. Kraft mills produce reburned lime onsite.

**Demand:** In 1983, pulp mills purchased about 980,000 tons of lime, some 6% of total consumption, which rose slightly to 16 million tons. In 1984, mill usage should increase 5% to 6%, as total demand rises about 6%. The rationalized steel industry's share increased to 35% of the total in 1983. Other applications include treatment of sewage, chemicals, and refinement of sugar.

**Sources:** The major manufacturers of merchant lime, produced mainly from calcite ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) are Genstar, Kerr-McGee, Marblehead Lime, Martin Marietta Chemicals, Mississippi Lime, Pfizer, Steetley Industries, and U.S. Gypsum. (Steetley purchased Domtar's Tacoma, Wash., plant in early 1981, while Domtar completed its withdrawal from U.S. production by closing its Bellefonte, Pa., facility in mid-1982.)

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, tight in eastern U.S., market in West; 1978, market to tight.

**Pricing:** Quicklime: 1984, $66.80/ton, bulk, f.o.b. works; 1983, $63.50/ton; 1982, $57.80/ton; 1981, $51.63/ton; 1980, $46.10/ton; 1979, $41.16/ton; 1978, $36.75/ton.

**Forecast:** In 1984, total lime demand and mill usage should reach 17 million tons and 1 million tons, respectively. Demand by some of the smaller end-use areas should go up 10% in 1984, although steel industry usage will be up about 7%.

## Polyvinyl alcohol

**Uses:** Polyvinyl alcohol (PVA) is employed by the paper industry mainly as a surface size for printing and writing papers and paperboard, and as a coating binder.

**Demand:** In 1983, paper industry usage of PVA was between 11 and 12 million lb, about 8% of the estimated total merchant demand of 140 million lb. In 1984, demand by paper and board mills should increase to between 12 and 13 million lb, while total consumption should reach the 155-million-lb level. Imports were up to 40 million lb in 1983 (from 21 million), and at the end of July 1984 they were at an annual rate of almost 55 million lb. PVA's largest end-use is for textiles (50%), followed by adhesives (25%), emulsifiers (12%), and other applications (5%).

**Sources:** U.S. producers of PVA, which is derived from the hydrolysis of polyvinyl acetate, are (in descending order of capacity): E.I. DuPont, Air Products & Chemicals, and Monsanto. Air Products & Chemicals and DuPont both make fully hydrolized (FH) PVA, while Monsanto produces only partially hydrolized (PH) material. Air Products & Chemicals also makes the PH grade and in midyear completed the first phase of its expansion at Calvert City, Ky. The second phase is due

onstream next September. DuPont's La Porte, Texas, expansion—which will allow it to make PH as well—should be ready in early 1985.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

**Pricing:** 1984, $1.05/lb, delivered; 1983, $1.05/lb; 1982, $1.05/lb; 1981, $1.00-$1.05/lb; 1980, 86.5¢-91.5¢/lb; 1979, 77.5¢/lb; 1978, 69.5¢/lb.

**Forecast:** Since the removal of the 4¢/lb temporary voluntary allowance on Jan. 15, PVA tags have held steady at the posted price and are not expected to change until 1985. Paper industry usage should increase between 3% and 4% next year and could reach 16 million lb by the end of the decade.

## Saltcake

**Uses:** Saltcake (sodium sulfate) is the main source of makeup sodium and sulfur values in kraft pulp mills.

**Demand:** In 1983, kraft pulp mills consumed an estimated 498,000 tons of saltcake, about 47% of the total consumption of 1.06 million tons. Mill usage in 1984 is expected to decrease slightly (less than 1%) to approximately 495,000 tons. Other major end-uses include detergents (41%) and glass manufacture (13%).

**Sources:** Sodium sulfate is produced from both natural deposits or as a byproduct in the manufacture of rayon, sodium bichromate, and hydrochloric acid. From 1980 to 1982, the share of natural sulfate dropped to 44% from 52%. In 1983, it increased slightly to 44.5% and is expected to remain at that level in 1984. There are three producers of natural sulfate: Great Salt Lake Minerals & Chemicals, Kerr-McGee, and Ozark-Mahoning (Div. of Pennwalt). Over the past year or so, three byproduct producers closed their plants, while one brought a new plant onstream at year-end 1983. The major synthetic producers now include Akzona, Allied Chemical, Avtex, Climax Chemical, Diamond Shamrock, and Lithium.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, tight to market; 1979, market to tight.

**Pricing:** 1984, $99/ton, f.o.b. producing plant; 1983, $99/ton; 1982, $79-$94/ton; 1981, $68-$79/ton; 1980, $60-$68/ton; 1979, $47-$52/ton; 1978, $35-$45/ton.

**Forecast:** Total sodium sulfate production in 1984 is expected to increase about 4%, although byproduct sulfate output should rise about 10%, while natural production drops about 2.5%. The long-term prospect for pulp mill saltcake consumption depends on the extent of chlorine dioxide substitution in the first bleaching stage. The effluent from $ClO_2$ generators contains sodium and sulfur values that can be used in place of purchased saltcake. As the economy continues to improve, mill demand in 1984 could rise another 5,000 tons or so. Imports from Canada, which dropped sharply in 1983 (to 272,000 tons), are expected to decrease further this year to about 240,000 tons. Total U.S. imports are also slated to decrease in 1984 to about 265,000 tons, based on seven-month shipments of about 155,000 tons.

## Sodium chlorate

**Uses:** The major use of sodium chlorate is for onsite generation of chlorine dioxide ($ClO_2$).

**Demand:** In 1983, pulp mills consumed an estimated 288,000 tons of $Na_2ClO_3$—85% of total apparent consumption of about 339,000 tons. Mill demand should increase in 1984 to about 296,000 tons. Other uses are chlorates (6%), uranium processing (4%), agriculture (3%), and miscellaneous applications (2%).

**Sources:** The major producers of sodium chlorate—derived from electrolysis of an acidified sodium chloride solution—include ERCO Industries, Georgia-Pacific, KemaNord Bleaching Chemicals, Kerr-McGee, Occidental Chemicals, Olin, and Pennwalt. Smaller facilities are operated by Brunswick Chemical, HO Process, Huron Chemicals, and Pacific Engineering. Canadian imports in 1983 accounted for about 32% of total chlorate demand.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, tight.

**Pricing:** 1984, $420/ton, f.o.b. works, freight equalized; 1983, $420/ton; 1982, $420/ton; 1981, $375/ton; 1980, $345-$375/ton; 1979, $335-$345/ton.

**Forecast:** As predicted last year, KemaNord Bleaching Chemicals (a division of Swedish-based KemaNobel) acquired Occidental Chemicals' Columbus, Miss., plant, which is slated for a 56% expansion by mid-1985. Imports from Canada in 1983 were 108,000 tons (86,000 tons in 1982), while imports in 1984 should reach the 130,000-ton mark (76,000 tons by the end of July).

## Sodium hydrosulfite

**Uses:** Sodium hydrosulfite is used as a bleaching agent for mechanical and deinked pulp.

**Demand:** In 1983, the paper industry used an estimated 17,000 tons (excluding hydrosulfite produced *in situ* from Borol). Apparent consumption was about 50,000 tons. The textile industry is the largest consumer of sodium hydrosulfite (used in vat dyeing) and accounts for about 40% of total demand. Other end-uses include clay bleaching (20%) and miscellaneous (2%).

**Sources:** There are still only two sodium hydrosulfite producers in the U.S.: Olin and Virginia Chemicals (a Celanese subsidiary). This year, Virginia completed major expansion programs at its plants at Bucks, Ala., and Leeds, S.C. Borol solution is produced solely by Morton-Thiokol's Ventron Div.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

**Pricing:** 1984, 60¢-63¢/lb (proprietary blends), f.o.b. producing point; 1983, 60¢/lb; 1982, 60¢/lb; 1981, 55¢-60¢/lb; 1980, 43.5¢-55¢/lb; 1979, 41.5¢-43.5¢/lb; 1978, 39.5¢-41.5¢/lb.

**Forecast:** Merchant sodium hydrosulfite consumption in 1984 may reach 17,500 tons, while apparent consumption increases to about 57,500 tons. Hydrosulfite produced via Borol is expected to hit the 8,000-ton level (100% basis), compared with the 7,050 tons used by the mills in 1983.

## Starch

**Uses:** Starches are the workhorse binders for coating mills and are also used as surface sizes, internal additives, and as adhesives for corrugated containers.

**Demand:** In 1983, the paper industry used an estimated 2.8 billion lb, unchanged from its requirements in the previous year, out of a total consumption of 4.45 billion lb. (In 1982, total demand was 4.3 billion lb.) In 1984, mill usage will go up slightly to 2.9 billion lb, while total demand rises to about 4.7 billion lb. Food, brewing, and textiles are other major end-uses for starch.

**Sources:** Producers are listed in the *P & P Buyers Guide 1981* (p. 32). About 90% of the starch used in the paper industry is cornstarch.

**Availability:** Unmodified: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market. Modified: 1984, market; 1983, market; 1982, market; 1981, tight to market; 1980, tight.

**Pricing:** Unmodified: 1984, $15.71-$17.68/100-lb bags, truckloads, f.o.b. plant; 1983, $11.50-$15.96/100 lb; 1982 $11.50-$12.25/100 lb; 1981, $11.25-$14/100 lb; 1980, $9.50-$10.50/100 lb; 1979, $9-$10/100 lb; 1978, $8/100 lb. (For bulk prices, deduct $1.25/100 lb.) Modified starch prices vary for each grade, but generally follow price trends of unmodified starch.

**Forecast:** An increase of more than 53% in farm acreage in 1984—brought about by the abandonment of the Payment-In-Kind program—has resulted in a "strong normal" crop of an estimated 7.5 billion bushels. Thus, prices began to fall in September (to $17.68/100 lb) after rising monthly since January. Another 50¢/100 lb drop is expected by year-end, with

a decrease of another $1/100 lb in early 1985. Mill demand should increase between 3% and 4% in 1985 to a predicted 3 billion lb, while total consumption goes up about 2% to 4.8 billion lb.

## Styrene-butadiene latex

**Uses:** The bulk (about 90%) of the styrene-butadiene latex (SBL) employed by the paper industry is used as a coating binder, the remaining 10% is accounted for by paper saturation (masking tape and wallpaper).

**Demand:** In 1983, an estimated 235 million lb of SBL were used by the paper industry, up about 7% from the previous year. On the other hand, total latex consumption recovered sharply to 700 million lb (up 11.5%), resulting in a slight decrease in the industry's share of the total to 33.5%. In 1984, paper and board usage is expected to rise to 248 million lb, while total demand increases to 800 million lb, reducing the industry's share to 31%. The major end-use (50%) is in carpetbacking and integral foam, followed by other textile applications and adhesives.

**Sources:** About 85% of the estimated 915 million lb of annual capacity in the U.S. is shared by four major suppliers (in descending order of capacity): Dow Chemical, Polysar, Reichhold Chemicals, and General Tire.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

**Pricing:** 1984, 75¢-79¢/lb (effective May 1, 1984); 1983, 71¢-75¢/lb; 1982, 71¢/lb; 1981, 65¢-71¢/lb; 1980, 59¢/lb; 1979, 53¢/lb; 1978, 40¢-43¢/lb.

**Forecast:** Monomer costs have been fairly steady during 1984, although styrene prices slipped about 1¢/lb in midsummer. Currently, lists for both styrene (35¢/lb) and butadiene (32¢/lb) are being discounted about 2¢/lb. Little change is anticipated in 1985, but freight costs are expected to rise significantly next year (about 10%). Thus, the next boost in SBL tags (expected in May) will be from 5% to 8%.

## Sulfur

**Uses:** Sulfite pulp mills consume the bulk of the sulfur used by the pulp and paper industry. Some sulfur is also used directly in kraft pulp mills.

**Demand:** Pulp mills used less than 1% of the total sulfur consumed in 1983, requiring about 97,000 metric tons. (Total consumption of Frasch and recovered sulfur was about 9.9 million tons.) The bulk of the sulfur purchased is for agchems, petroleum refining, rubber, plastics, inorganic chemicals, and other miscellaneous applications.

**Sources:** The share of elemental sulfur produced in 1983 via the Frasch route vs that from refineries and sour-gas production dropped to 39.5% (60% in 1981). However, it is expected to increase to 43% in 1984. Major Frasch producers include Duval, Freeport Sulphur, and Texasgulf. Major suppliers among the more than 60 firms recovering sulfur include Amoco, Atlantic Richfield, Chevron Chemical, Exxon Chemical Americas, Getty, Mobil Chemical, Pursue Gas, Standard (California and Indiana), Texaco Chemical, and Union Oil.

**Availability:** 1984, market to slightly tight; 1983, market; 1982, market; 1981, tight to market; 1980, tight; 1979, very tight.

**Pricing:** 1984, $124 to $131/metric ton, crude, bright, f.o.b. Gulf Coast ports; 1983, $131 to $124/metric ton; 1982, $138.75 to $132.50/metric ton; 1981, $131.35 to $138.75/metric ton; 1980, $103.31 to $109/metric ton; 1979, $70.60/metric ton; 1978, $61.50/metric ton. Prices of both Frasch and recovered sulfur rose in 1984. In the third quarter, the f.o.b. Tampa, Fla., price for Frasch went up again to $145.14/metric ton, following a boost in March to $137.76/metric ton. The Gulf Coast recovered tag also rose earlier this year to $131.36/metric ton. With the $9.84/metric ton discount on Frasch still in effect, the differential with recovered sulfur has decreased to about $4/metric ton from the $20/metric ton prevailing in 1981.

**Forecast:** The recovery by the fertilizer industry in 1984 should result in a 15% to 16% increase in total sulfur consumption to an estimated 11.4 million metric tons. Thus, selling prices should continue to rise and are expected to go up about 5% in 1985. Usage by the pulp and paper industry is also expected to rise in 1984 to about 110,000 metric tons.

## Titanium dioxide

**Uses:** Both rutile and anatase grades of titanium dioxide ($TiO_2$) are used by fine paper and board mills as filler and in coating.

**Demand:** In 1983, mill demand for $TiO_2$ recovered to an estimated 197,000 tons out of a total apparent consumption of about 839,000 tons. In 1984, mill usage should exceed the 215,000-ton level as total demand rises 10%. The largest end-use is by the paint industry (50%), followed by plastics (12%), rubber, and ceramics.

**Sources:** There are now five $TiO_2$ producers in the U.S. (in descending order of capacity): E.I. DuPont, SCM, American Cyanamid, Kerr-McGee, and Gulf + Western. SCM acquired G+W's Ashtabula, Ohio, plant in 1983 and is expanding it by about 22%. Kerr-McGee's smaller expansion came onstream in the third quarter of 1984.

**Availability:** Anatase: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market. Rutile: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market.

**Pricing:** Anatase: 1984, 70¢/lb, delivered; 1983, 70¢/lb; 1982, 70¢/lb; 1981, 58¢-70¢/lb; 1980, 57¢/lb; 1979, 53¢/lb. Rutile: 1984, 75¢/lb, delivered; 1983, 75¢/lb; 1982, 75¢/lb; 1981, 63¢-75¢/lb; 1980, 57¢/lb; 1979, 59¢/lb.

**Forecast:** Following a 5¢/lb hike on July 1, $TiO_2$ market prices finally matched the posted levels (in effect since late 1981). This was the third boost in 1984. The previous increases were instituted in April and January. As the economy continues to improve, there could be a further 5% to 6% hike in 1985.

## Other major chemicals

**Alum:** Total alum demand has been virtually steady for the fifth year in a row, although bulk liquid prices finally rose on Jan. 1, 1984—the first hike since July 1981. The 9% boost brought lists to $145/ton in the North and $137/ton in the South. If raw material and freight costs continue to increase, there may be another boost in early 1985.

**Casein:** The list price of industrial-grade casein is still at $1.365/lb and is expected to hold there to the end of 1984.

**Polyethylene:** Low-density, extrusion-coating grade resin had dropped to 37¢/lb at the beginning of 1983, but moved up to the range of 40¢-42¢/lb in midyear and remained at that level until late summer of 1984. The high end of the range has held steady, but the low end dropped to 38¢/lb in August.

**Polyvinyl acetate:** List prices for polyvinyl acetate coating-grade emulsions went up 4¢/dry lb at the beginning of June, bringing the posted tag to 71¢/dry lb (about 36¢/lb, 50% basis) for bulk, tanks, f.o.b. works. The price boosts were attributed mainly to continuing increases in the cost of vinyl acetate monomer (VAM).

**Rosin sizes:** Rosin usage by the mills (100% basis) should reach an estimated 320 million lb in 1984 as more mills switch from dispersed grades to paste grades. Prices for 70% pale material have held steady at $36/lb since early 1983.

**Wet-strength resins:** List prices of natural trona, unchanged since November 1982, rose $6/ton on June 1, 1984 to $90/ton, f.o.b. Wyoming mines. However, a temporary voluntary allowance (TVA) of $11/ton has been in effect since late February—a $4/ton reduction from the $15/ton TVA introduced in October 1983. Synthetic sodium carbonate is still being listed at $132/ton, f.o.b. Syracuse, N.Y.

The posted prices for wet-strength resins, unchanged since July 1, 1982, rose about 7% early in 1984. Polyamide-epichlorohydrin (PEC) prices (12.5% solids) are now listed at $25.09/100 lb ($2/lb) on a dry basis), while urea formaldehyde (UF) is priced at $21.40/100 lb and $15.30/100 lb, respectively, for 35% and 25% solids content. (UF dry-weight price is 61¢/lb.) A 6% hike is expected some time in 1985.

# Canadian chemical use to rise in '84 as selling prices continue moving up

■ Recovery has continued in 1984 for the Canadian pulp and paper industry despite production setbacks from labor/management disputes. Following production increases in 1983 of 13% and 8% for pulp and paper production, respectively, output in the first quarter of 1984 was depressed by a two-month lockout of the British Columbia industry.

Chemical demand strengthened in the second and third quarters as the industry ran at higher rates. Increased demand and better mill profitability spurred chemical suppliers to raise prices around midyear. Indications are that chemical consumption in Canadian mills will reach new highs in 1984.

At the end of July, total pulp production was 5% higher than in the first seven months of 1983. Most of the increase relates to mechanical pulps, which grew 11%. Chemical pulp output rose only 0.2%. The B.C. lockout contributed to a 7% decline in bleached softwood kraft, which was partly offset by a 23% increase in eastern-based bleached hardwood kraft.

Paper production during the first seven months was 9% above the 1983 pace. The largest gain (21%) occurred for groundwood printing and specialty types. Newsprint output rose 7%, whereas gains of 10% to 12% were recorded for book and writing papers and paperboards. Mill inventories of paper were down 17%, and pulp inventories were down 24%.

The inorganic chemicals price index rose 6.1% by July 1984 (Figure 3), reflecting improved demand in mills and other industries. Discounting has subsided considerably and is mainly confined to caustic soda. Over the year, market prices for caustic soda rose about 20% via hikes on Jan. 1 and Oct. 1. Increases of about half that size are forecast for early 1985, although product will still be discounted from list. Chlorine prices rose 5% on July 1 and are close to list price. A hike in the list could occur in early 1985.

In early 1984, market prices for sodium chlorate were unchanged from 1982 levels. A price hike scheduled for early 1984 was rescinded because of resistance from mills. However, by midyear mills were showing improved performance, and a 4.4% market price hike was established. ERCO, QueNord, and BCM Technologies are expanding chlorate plants, and a new chlorate producer—Alby Klorat Div. of Swedish Match—is scheduled to open a plant at Valleyfield, Que., in early 1986.

Hydrogen peroxide list prices rose 10% in June, reflecting movement in the U.S. where most product is sourced for the Canadian market. Peroxide growth pros-

*FIGURE 3:* **Canadian price index changes for 1984.**

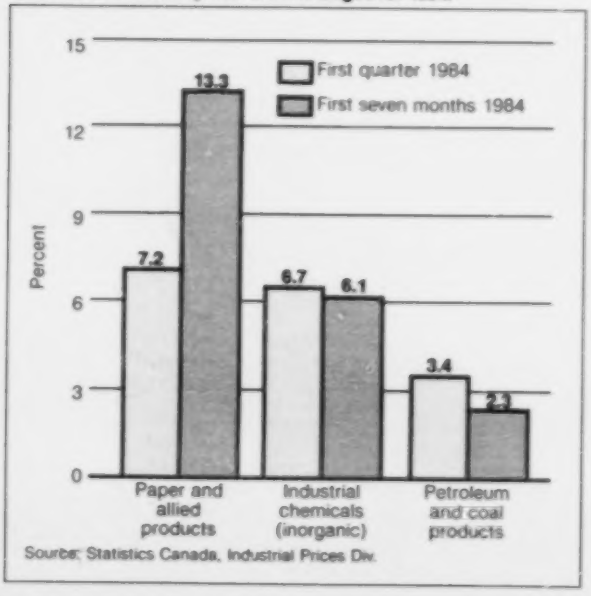
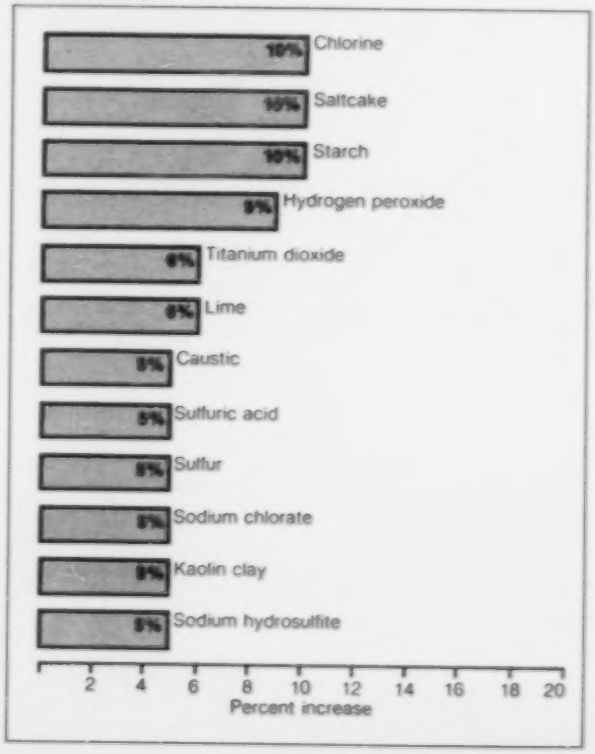



*FIGURE 4:* **Projected Canadian price increases for major chemicals in 1985.**



pects have enticed two firms to plan new production plants so that Canada will have domestic supply by 1986. DuPont Canada's Maitland, Ont., facility will not only serve the eastern Canadian market, but export to the U.S. as well. FMC Canada's plant at Squamish, B.C., will target western Canada's pulp industry for its sales. ■

**DEFINITIONS OF SURVEY AVAILABILITY TERMS:**

**Very tight**—On allocation; demand significantly greater than supply.
**Tight**—Demand slightly greater than supply.
**Market**—Supply/demand in balance or excess capacity available.

# CHEMICAL SURVEY: CANADA

## Aluminum sulfate

**Uses:** Alum usage is split about 50:50 between the precipitation of rosin size and pitch control/water treatment applications.

**Demand:** In 1983, paper mills consumed 108,000 tons, or 57% of total alum consumption. In 1984, total mill usage is expected to increase to 115,500 tons (55.5% of total demand), of which about 56,000 will be used for sizing. Total alum consumption in 1983 was 190,000 tons (up 11% from the previous year), and in 1984 should reach 205,000 tons. Municipal water and sewage treatment applications now account for about 35% of the total, with the balance going into pigments and other miscellaneous end-uses.

**Sources:** There are now three major Canadian alum producers—Alcan Smelters & Chemicals, Allied Canada's Allied Chemical Div., and United Chemicals. The latter operates three plants in western Canada (since midyear) and has overtaken Alcan as No. 2 producer. In fourth spot is C-I-L Sulfur Products West (formerly Inland Chemicals) with two plants, while Borden Chemical has a small plant in Manitoba, Que.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market to tight.

**Pricing:** 1984, $146.97/ton, liquid (17% $Al_2O_3$), bulk, f.o.b. works; 1983, $131.54-$139.70/ton; 1982, $131.54/ton; 1981, $100.70-$119.75/ton; 1980, $86-$100.70/ton; 1979, $79-$86/ton.

**Forecast:** Alum prices rose about $7.25/ton at the beginning of this year, the previous $8.15/ton boost occurring on Apr. 1, 1983. No further hike is expected in 1984. Mill usage should grow between 2% and 3%/year through 1988, while total demand should increase at about 4%/year primarily due to the expected 8% to 9% growth in sewage treatment uses.

## Caustic soda

**Uses:** NaOH is used in the extraction stages of kraft or sulfite bleach plants, for hypochlorite makeup, and in sulfite pulping.

**Demand:** In 1983, pulp mills consumed about 983,000 tons of caustic (61% of total domestic demand), with 737,000 tons used in the bleach plant. An additional 246,000 tons were employed for pulping applications. In 1984, demand should rise between 5% and 6% to 1,037,000 tons (767,000 tons for bleaching end-uses). The next largest end-uses are in the production of propylene oxide and alumina, which last year accounted for 7% and 5.5%, respectively, of total demand.

**Sources:** Caustic is a coproduct of chlorine production. See the chlorine profile for major producers.

**Availability:** 1984, market; 1983, market; 1982, tight to market; 1981, very tight to market; 1980, very tight; 1979, tight; 1978, tight.

**Pricing:** 1984, $417/ton, 50% solution, bulk, f.o.b. works, freight equalized; 1983, $417/ton; 1982, $381-$417/ton; 1981, $293-$381/ton; 1980, $195-$293/ton; 1979, $183-$195/ton; 1978, $175-$183/ton.

**Forecast:** Caustic lists—still unchanged since April 1982—should remain at the $417/ton-level until mid-1985, although off-list tags were slated to rise last month to about $413/ton. The recovery in chemical pulp production in the second half of 1984 is expected to continue next year, resulting in an estimated mill demand in 1985 of about 1,100,000 tons.

## Chlorine

**Uses:** Chlorine's major use by the pulp and paper industry is as a bleaching agent in kraft and sulfite pulp mills. A smaller use is for onsite hypochlorite makeup.

**Demand:** In 1983, the pulp and paper industry used about 548,000 tons of chlorine, up about 9% from the 502,000 tons consumed in 1982. In 1984, demand by mills is expected to increase about 4% to 571,000 tons, while the industry share of total demand rises slightly to 39%. The major end-use for chlorine, ethylene dichloride (EDC) production, should account for 41% of the total in 1984.

**Sources:** Chlorine is produced along with caustic by the electrolytic reduction of brine. Major chloralkali producers include C-I-L, Canadian Occidental Petroleum, Dow Chemical Canada, FMC Chemicals, and PPG Industries.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, tight; 1978, tight.

**Pricing:** 1984, $344.75/ton, bulk, f.o.b. works; 1983, $308.45-$344.75/ton; 1982, $254-$281.25/ton; 1981, $225 to $254/ton; 1980, $195-$225/ton; 1979, $163-$195/ton; $1978, $145-$163/ton.

**Forecast:** The traditional annual hike in chlorine tags did not take place in 1984, the last boost occurring July 1, 1983. The first hike last year was on Jan. 1. No changes are expected much before mid-1985. Chlorine usage by the mills will decrease over the longer term as $ClO_2$ use grows, but not as quickly as originally projected. Only one mill has replaced the theoretical maximum (70%) of its first-stage chlorine requirements, while most mills operate in the 6% to 8% range. Four mills are replacing between 25% and 30% of their chlorine needs. In the immediate future, chlorine demand by the mills should grow about 3%/year to 1988.

## Hydrogen peroxide

**Uses:** The pulp and paper industry employs hydrogen peroxide ($H_2O_2$) as a bleaching agent for mechanical and chemical pulps. It is also used in the bleach plant as a partial replacement for $ClO_2$.

**Demand:** In 1983, Canadian mills used an estimated 6,400 tons of $H_2O_2$—about 72% of total peroxide consumption. In 1984, mill usage is predicted to reach 7,700 tons—70% of total demand. Other end-uses include textiles (10%), water treatment (5%), and miscellaneous applications (15%).

**Sources:** All of the peroxide consumed in Canada is still imported. The major importers are C-I-L (from FMC Corp.), Du Pont Canada (from its U.S. parent), and Interox Canada (via its new Toronto terminal). European product is handled by several distributors.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market to tight; 1979, market; 1978, market.

**Pricing:** 1984, 58.7¢-65¢/lb (effective July 1, 1984), bulk, 70% solution, f.o.b. Toronto/Montreal; 1983, 58.7¢/lb; 1982, 52.5¢/lb; 1981, 52.5¢/lb; 1980, 44¢-47.5¢/lb; 1979, 41¢-44¢/lb; 1978, 36¢-41¢/lb.

**Forecast:** The 6.3¢/lb hike in July was the first price change in 18 months. The next boost should occur around mid-1985. Consumption of $H_2O_2$ by mills could reach the 17,000-ton level by 1988.

## Hydrosulfites, borohydride solution

**Uses:** Almost all newsprint mills bleach groundwood with hydrosulfite purchased or generated onsite via the Borol process.

**Demand:** In 1983, the pulp/paper industry used an estimated 7,400 tons (100% basis) of merchant sodium hydrosulfite and an added 9,100 tons Borol (12% active borohydride basis). Vat drying of cotton accounted for about 10.5%.

**Sources:** No hydrosulfite is produced in Canada. VirChem Canada imports blended hydrosulfites from its U.S. parent, Virginia Chemicals (a subsidiary of Celanese), while various distributors import product from Europe. Morton-Thiokol's Ventron Div. supplies Borol.

**Availability:** Hydrosulfite blends: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market.

**Pricing:** Blended: 1984, 71¢-72¢/lb, delivered, eastern Canada; 1983, 69.4¢-71¢/lb; 1982, 69.4¢/lb; 1981, 59¢-64¢/lb; 1980, 51.4¢/lb. Nonblended: 1984, 68¢/lb; 1983, 61.2¢-68¢/lb; 1982, 61.2¢-71.5¢/lb; 1981, 61.2¢-66.4¢/lb; and 1980, 56¢-66.4¢/lb.

**Forecast:** Mill usage should rise 13.5% to 8,400 tons (100% basis) in 1984. Last year, the increase was only 330 tons. Annual demand growth for the next four years should average 2%. Borol usage decreased in 1983 about 1%, but should grow about 13% in 1984 (to 10,300 tons). However, the average annual increase to 1988 will be only 1% to 2%.

## Kaolin

**Uses:** Kaolin is used by paper and paperboard mills as a coating pigment (58%) and as a filler (42%).

**Demand:** In 1983, coating applications consumed an estimated 130,000 tons of kaolin clay, while an additional 90,500 tons were used as a filler, representing about 86% of total kaolin demand. In 1984, usage should increase to 143,000 tons and 104,500 tons, respectively. The increase in imports last year, the first since 1980, has continued in 1984. At the halfway mark, U.S. shipments were annualized at 289,000 tons, compared with the 274,000 tons imported in 1983.

**Sources:** U.S. suppliers are listed in *P & P Buyers Guide 1984* (p. 157). Since 1981, imports from the U.K. have been minimal, albeit 1983's 1,550 tons were almost twice those imported in 1982.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market to tight.

**Pricing:** Water-washed No. 1 coating grade, 1984, $255/ton, f.o.b. Georgia; 1983, $255/ton; 1982, $218/ton; 1981, $215-$218/ton; 1980, $208 to $215/ton; 1979, $194 to $208/ton. Dry-ground, air-floated filler grade: 1984, $58/ton (same basis); 1983, $58/ton; 1982, $60/ton; 1981, $47-$60/ton; 1980, $43-$47/ton; 1979, $35-$43/ton.

**Forecast:** Mill demand should rise about 5% for both coating and filler pigments over the next four years. Consumption by 1988 should be 173,500 tons and 127,000 tons, respectively.

## Lime

**Uses:** Kraft mills purchase lime to supplement calcium requirements in the recovery cycle.

**Demand:** In 1983, pulp mills purchased an estimated 243,000 tons of lime (12.5%) out of a total consumption of just under 2 million tons. In 1984, mill lime usage should rise by 7,000 tons. The largest lime consumers are iron and steel mills, which used 595,000 tons in 1983, up slightly from 1982's 569,000 tons. Other lime end-uses, in descending order of volume, include chemicals, uranium recovery, nonferrous smelters, water and sewage treatment, and sugar refining.

**Sources:** There are still nine merchant lime producers in Canada, although two plants have changed hands. Domtar has left the lime business, recently selling its remaining facility in Beachville, Ont., to BeachviLime (Dofasco's captive supplier). Late in 1983, Domtar's Joliette, Que., plant was sold to Jolichaux. BeachviLime is now the largest firm in the country (more than 1 million tpy), followed by Steel Bros. Canada, and Jolichaux.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, tight to market; 1978, market.

**Pricing:** Quicklime: 1984, $63.60/ton, f.o.b. Ontario producing point; 1983, $59-$63.60/ton; 1982, $55-$59/ton; 1981, $46-$55/ton; 1980, $40.98-$46/ton; 1979, $34.98/ton.

**Forecast:** The percentage of total lime consumption accounted for by mill purchases will decline over the long term, particularly as more mills opt for oxygen enrichment in the lime kiln. Meanwhile, through 1988, merchant lime usage by the mills should increase between 1.5% and 2%/year. The partial recovery in steel output in 1983 reversed the slide (since 1981) in total lime demand, which rose about 1.5%, compared with the 8.5% drop in 1982. Demand should grow 5% in 1984, while steel industry usage rises to 613,000 tons. Exports continue to drop—about 170,000 tons expected in 1984.

## Saltcake

**Uses:** Saltcake is used by kraft pulp mills for sodium and sulfur makeup.

**Demand:** In 1983, pulp mills used 279,000 tons—about 79% of total sulfate demand (353,000 tons). Recovery in the market pulp area resulted in a 10.5% boost from 1982. Mill consumption should rise another 10.5% in 1984.

**Sources:** Most sodium sulfate comes from the Glauber's salt deposits in Alberta and Saskatchewan. Byproduct sulfate capacity is only 12% of total. Major producers include Alberta Sulphate, Hudson's Bay Mining & Smelting's Francana Minerals Div., Midwest Chemicals, Ormiston Mining & Smelting, and Saskatchewan Minerals. The latter firm closed its Gladmar (50,000 tpy) plant in May 1983 after reopening the former Sybouts Sodium Sulphate facility in May 1982. SaskMin's small (40,000 tpy) Bishopric unit is still on indefinite standby since January 1983. The two byproduct sulfate producers are Courtaulds and Ontario Paper, both in the East.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

**Pricing:** 1984, $81/ton, bulk, saltcake, f.o.b. mine; 1983, $75-$81/ton; 1982, $70-$75/ton; 1981, $55-$70/ton; 1980, $50-$55/ton; 1979, $50/ton; 1978, $45-$50/ton.

**Forecast:** There has been no change in the price of saltcake since April 1983 and none is expected in 1984. If pulp markets continue to improve, an 8% to 10% boost could occur by the second or third quarter in 1985. Over the long term, more effluent recyling from $ClO_2$ generators will reduce the amount of saltcake purchased by mills.

## Sodium chlorate

**Uses:** Sodium chlorate is used in chlorine dioxide generators.

**Demand:** In 1983, pulp mills used an estimated 208,500 tons of sodium chlorate, about 95% of total chlorate consumption (219,500 tons). The turnaround in pulp markets increased mill demand last year by about 14%. Uranium leaching, the only other significant end-use for chlorate, required about 10,000 tons in 1983.

**Sources:** Canadian merchant producers of sodium chlorate are BCM Technologies, Canadian Occidental, ERCO Industries, QueNord, and PPG Industries. BCM's new plant near Windsor, Ont., went onstream in last year's third quarter. Swedish Match has received Canadian government approval to build a plant in Montreal, while QueNord (a KemaNobel subsidiary) plans to double capacity of its Magog, Que., facility by 1986. The three remaining captive producers are B.C. Chemicals, St. Anne Chemical, and Saskatoon Chemicals.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market; 1978, tight.

**Pricing:** 1984, $435/ton, bulk, f.o.b. works, freight equalized; 1983, $435/ton; 1982, $410/ton; 1981, $365/ton; 1980, $310-$330/ton; 1979, $310-$330/ton; and 1978, $250-$281/ton.

**Forecast:** Pulp mill demand for sodium chlorate is expected to increase by about 8% to 225,000 tons in 1984 and then continue to grow about 3%/year to 1988. No boost in the list price, effective Jan. 1, 1983, is expected before next year.

## Starch

**Uses:** The paper industry's major use of starch (about 80%) is at the size press, with some employed in coating. Wet end applications account for a small quantity.

**Demand:** In 1983, the paper industry used an estimated 76,000 tons of starch, about 15% of total consumption; this should increase by about 9,000 tons in 1984. The production of corn sweeteners accounted for about 67.5% of total demand in 1983. Other end-uses include food starches, corrugated and other adhesives, ore flotation, and other applications.

**Sources:** Most of the starch used by mills comes from corn. Major cornstarch producers include Casco (new joint venture with John Labatt, 70% owned by Canada Starch), Nacan Products, and St. Lawrence Starch. International Grain Products, a small cornstarch producer, also supplies wheat starch.

**Availability:** Unmodified: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market. Modified: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market.

**Pricing:** 1984, native pearl (unmodified), $21.77/100 lb., truckload, bags, f.o.b. Toronto, Ont./Montreal, Que.; 1983, $19.78-$21.77/100 lb; 1982, $19.25-$20.69/100 lb; 1981, $19.25/100 lb; 1980, $14.59 to $19.25/100 lb; 1979, $14.59/100 lb; 1978, $12.60-$14.59/100 lb. Modified starch prices follow the price trend for unmodified starches.

**Forecast:** During the past year, starch prices fluctuated from $20.69/100 lb at the beginning of the year to $19.78/100 lb on Apr. 4 and then rose to $21.77/100 lb on Aug. 8. Tags have remained steady since then but may go up about 10% in 1985. The 85,000-ton demand by the mills expected in 1984 will increase their share to 16% of total starch usage (an estimated 531,000 tons). Average annual growth in mill demand to 1988 should be about 1.5%.

## Sulfur

**Uses:** Sulfite pulp mills that do not purchase liquid sulfur dioxide burn sulfur to produce gaseous $SO_2$ for sulfite and bisulfite cooking liquor makeup. $ClO_2$ generation and other uses in the bleach plant consume small amounts.

**Demand:** In 1983, an estimated 209,000 metric tons of sulfur were purchased by the Canadian pulp and paper industry, accounting for about 28% of total consumption (about 746,000 metric tons). In 1984, the industry's usage is expected to increase about 4.5% to 218,000 tons, 28% of total demand. The largest end-use for sulfur is sulfuric acid production (65%), followed by carbon disulfide, rubber vulcanization, and other miscellaneous applications.

**Sources:** All sulfur produced in Canada is recovered, either from sour-gas operations or petroleum refineries. Major producers include Amoco, Canadian Occidental Petroleum, Canterra Energy, Chevron Standard, Dome Petroleum, Petrogas Processing, Shell, and Westcoast Transmission.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, tight to market; 1980, tight; 1979, tight.

**Pricing:** 1984, crushed, slate, or molten, $83.64/metric ton, f.o.b. producing point; 1983, $78.72 to $83.64/ton; 1982, $73.80 to $81.18/ton; 1981, $59.98 to $74.48/ton; 1980, $32.76 to $59.98/ton; 1979, $24.82 to $29.79/ton.

**Forecast:** Although sulfur list prices have not increased in 1984, the average selling prices for North American shipments have gone up since the beginning of this year. By June the average had risen to $68.80/metric ton from the $60.68/ton prevailing in January and the $52.64/ton recorded for December 1983. Despite an estimated 4.5% increase in pulp/paper industry consumption this year, mill usage over the longer term will drop; demand by 1988 could fall to 180,000 metric tons.

## Sulfuric acid

**Uses:** The major use of sulfuric acid ($H_2SO_4$) is in the kraft pulp mill for chlorine dioxide generation.

**Demand:** In 1983, 262,500 tons of sulfuric acid were consumed by Canadian pulp mills out of a total of 3.2 million tons. Pulp mill use in 1984 is expected to increase to 278,000 tons. Phosphoric acid production, the major end-use, accounted for about 56% of the total in 1983, up from 54% the previous year. Other end-uses include agricultural chemicals, petroleum refining, soaps and detergents, and viscose rayon.

**Sources:** Major merchant producers (in descending order of capacity): Inco Metals, Cominco, Canadian Electrolytic Zinc (Noranda), Kidd Creek Mines, and C-I-L Sulfur Products West (formerly Inland Chemicals). C-I-L also markets acid produced by Inco and Kidd Creek, as well as that not required captively by Falconbridge Nickel. Noranda markets acid from CEZ and Gaspe Copper Mines. Esso Chemicals Canada, International Minerals & Chemicals, and Western Cooperative Fertilizers are the major captive acid producers.

**Availability:** 1984, market; 1983, market; 1982, market; 1981, tight to market; 1980, market to tight; 1979, tight to market; 1978, very tight.

**Pricing:** 1984, 66° Baume, $94.35/ton, bulk, f.o.b. producing points, eastern Canada; 1983, $89.63 to $94.35/ton (effective Dec. 15, 1983); 1982, $84.55/ton; 1981, $69.31 to $84.55/ton; 1980, $60.87 to $69.31/ton; 1979, $52.40 to $60.87/ton.

**Forecast:** Pulp mill acid consumption rose 5% in 1984 (compared with an 8% hike last year), but mill demand to 1988 is only expected to grow, on the average, about 1%/year. Sulfuric acid list prices have remained steady throughout 1984, but an 8% to 10% boost is predicted for 1985.

## Titanium dioxide

**Uses:** About 90% of the anatase titanium dioxide ($TiO_2$) used by the paper industry is employed for fine paper applications, with the balanced used in paperboard.

**Demand:** Mill usage in 1983 increased 13% to 9,400 tons, 13.5% of a total demand of 69,400 tons. In 1984, mill demand should reach 10,500 tons. Last year, total consumption increased between 6.5% and 7% as the major end-use for $TiO_2$—the paint industry—recovered slightly (6%) from 1982. Its share went down to 55.5% of the total (from about 56%), while plastics applications account for about 17%.

**Sources:** There are two domestic producers—NL Chemicals Canada and Tioxide of Canada—with a combined capacity of 88,000 tons.

**Availability:** Untreated anatase: 1984, market; 1983, market; 1982, market; 1981, market; 1980, market; 1979, market.

**Pricing:** 1984, $80-$85/100 lb, untreated anatase, delivered, truckload, bags; 1983, $80/100 lb; 1982, $74.50-$80/100 lb; 1981, $69-$74.50/100 lb; 1980, $59-$69/100 lb; 1979, $48.50-$59/100 lb (Note: bulk slurry carries a 50¢/100 lb premium.)

**Forecast:** List prices for $TiO_2$ finally rose 5¢/lb on Sept. 10, having remained steady since Jan. 18, 1982. However, a 2¢/lb temporary valuation allowance (TVA) was in effect for nine months in 1983. Since then, product was moving at list prices. The new tag is expected to remain in force for at least the first half of 1985. Mill usage is expected to increase about 6%/year over the next four years. Total demand will grow between 6% and 7% during that time.

# Containerboard quality changes as

## Carton palletizing and preprinting require crush-resistant and smooth-surfaced containerboard that is best produced with multifourdriniers

By K. FLINKMAN and T. WILLNER

During recent years, new trends in the packaging industry have led to new quality requirements for linerboard. Although the U.S. is the largest producer of containerboard, these new trends are more prevalent in Europe than in North America. Two major changes are occurring. First, it has become more important to measure the top-to-bottom compressive strength of the container itself, rather than the strength of containerboard base materials alone. Second, changes in purchasing habits for consumer goods have caused a new advertising medium to emerge—the container package itself.

**CRITERIA CHANGES.** Containerboard has been traditionally used only as a transit packaging medium to give the goods necessary protection from the environment. The bursting strength of the linerboard and the corrugating medium has been the main quality criteria to be met. The printing quality has been indifferent—nothing better has been required because the main purpose of the print was to identify the contents of the package to the transporter or to the warehouse manager. There has been very little use for additional colors.

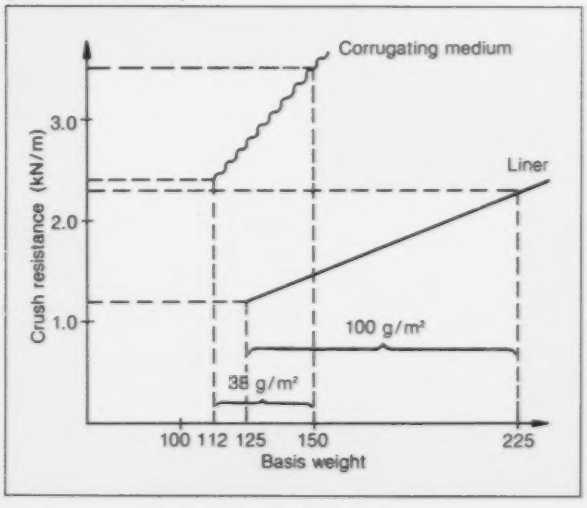
Changes in the distribution system have caused more transportation to take place on pallets. Boxes now remain stacked instead of being handled individually. Thus, users of corrugated boxes require boxes that can withstand stacking while still protecting goods against the environment.

Additional measuring methods that would better relate to the top-to-bottom compressive strength of the container have been studied. Such tests are the edge crush test (ECT) for corrugating medium, and the ring crush test (RCT) or STFI test for the board components.

It has now been widely accepted that the main criteria for box evaluation should be the strength of the finished box and not, for example, the mullen strength of the linerboard. This allows for a more economical composition of corrugated board to be used. Crush resistance of containerboard increases with the basis weight, but significant differences exist between the effects of liner and corrugating medium basis weights. Figure 1 shows that for kraft liner, an increase of 1 kN/m in crush resistance is achieved by adding 100 g/m² of liner at low basis weights. The higher the basis weight of the liner, the smaller the increase in crush resistance.

For corrugating medium, the increase in crush resistance is linear—1 kN/m increase in crush resistance can be achieved by adding only 38 g/m² of corrugating medium. This factor has made the use of heavier corrugating mediums possible in Europe.

*FIGURE 1:* **Crush resistance vs basis weight (Source: Finnboard).**




**CHANGES IN GRAPHICS.** Increasingly, product transport packages are also used as consumer packages, especially in discount stores or in cash-and-carry-type markets. Some typical goods sold this way include small appliances, tools, toys, and home computers. In addition, the drink and ready-made food trades are users of secondary packaging as an advertising medium. More and more purchasing decisions today are not made until the consumer is at the store. This has led to increasingly dramatic displays for special offers in supermarkets. Both a strong visual impact and an instant brand identification must be provided by the packaging.

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# packaging makes new demands

The use of white top liner (either of bleached pulp or clay coated), and preprinting of linerboard have made better graphics possible. The market share of white or mottled top linerboard in Europe is currently 18% of the corrugated board market, and it is expected to grow even more. More coated linerboard is also on the market as the new or rebuilt machines with on-machine coaters of the latest technology have started operation. The latest preprinting development is to have one station to print a white base on the board. The increased use of colors in linerboard printing in Europe is shown in Table 1.

*TABLE 1:* **Percentage of printed corrugated board.**

| | % of tonnage | | | Expected annual increase 1981-86 | | |
|---|---|---|---|---|---|---|
| | U.K. | Fed. Rep. Germany | France | U.K. | Fed. Rep. Germany | France |
| Unprinted | 35 | 35 | 20 | +1 | +1.5 | +1.5 |
| One color | 35 | 34 | 60 | −1 | +2 | +0.5 |
| Two colors | 20 | 20 | 10 | +1 | +3.5 | +2 |
| Three colors | 7 | 7 | 7 | +7 | +4 | +8 |
| Four colors | 3 | 4 | 3 | +4 | +5 | +7.5 |
| Total | 100 | 100 | 100 | +1 | +2.5 | +2 |

The preprint not only improves the graphics, it also results in stronger corrugated board—possibly allowing a reduction in sheet weights. Preprinting also makes it possible to use accurate product bar codes on the package so separate coding labels will not be necessary.

The increased use of corrugated boxes as an advertising medium has led to new requirements for linerboard. To have better graphics in several colors, the base material must also be better. A greater need for surface smoothness also exists if the board will be clay coated. The uniformity of the sheet both in basis weight and moisture can become a problem with older board machines. To keep the register in preprinting, it is necessary to have a low and consistent shrinkage factor of the liner sheet.

The sheet must be uniform to get the full benefit from modern, high-speed converting machines. Optimum sheet moisture for the converter is about 8%. A bad moisture profile or a moisture difference between the two liners causes warping and impairs the runability of the corrugator.

**CHANGES IN BOARD MACHINE DESIGN.** How have these changes in the containerboard market affected the design of board machines? The new requirements for linerboard have created new types of board machines that have one thing in common: the wet end of the machines is composed of several formers and, in many cases, of multiple fourdriniers.

It is evident that a top ply produced with a fourdrinier has a superior formation compared with one produced with a secondary headbox. Even while the continuous development of headboxes has improved the

*TABLE 2:* **Measurements of MD/CD strength ratio from random samples of various machines.**

| Mill | Machine wet end | Tensile strength ratio MD/CD |
|---|---|---|
| A (Sweden) | Fourdrinier and secondary headbox | 2.6 |
| B (Finland) | Fourdrinier and secondary headbox | 2.9 |
| C (United States) | Fourdrinier and secondary headbox | 2.6 |
| D (Sweden) | Four fourdriniers | 2.2 |
| E (Sweden) | Two fourdriniers | 1.8 |

*TABLE 3:* **Recent multifourdrinier wet ends for manufacturing containerboard.**

| Company | Startup year | Product | Supplier of board machine |
|---|---|---|---|
| ASSI, Frövifors Bruk AB, Sweden | 1981 | Liquid packaging board, kraft linerboard | Tampella |
| INPACSA SA, Spain | 1983 | Test liner, white top liner | Emua (Tampella licensee) |
| Manville Forest Products Corp., United States | 1985 | Bottle carrier board, liquid packaging board, kraft linerboard | Tampella |
| SAPPI Ltd., South Africa | 1985 | Liquid packaging, kraft linerboard | Tampella |
| Nettingsdorfer Papierfabrik AG, Austria | 1984 | Kraft linerboard, corrugating medium, liquid packaging medium | Voith |
| Chesapeake Corp., United States | 1985 | Linerboard | Voith |

design of the secondary headbox, a fourdrinier allows better control and adjustment of sheet properties.

**ADVANTAGES OF MULTIFOURDRINIERS.** The MD/CD strength ratio of the board is lower (and it is also adjustable) with a fourdrinier (Table 2). This improves the RCT in the cross direction. The sheet uniformity is increased by going to multi-ply machines, as the random variations are reduced by $1/\sqrt{n}$, where n is the number of plies. When using several fourdriniers, each ply can be controlled separately for best overall uniformity independent of the operating conditions.

Multi-ply forming on separate formers allows for the use of different consistencies at each forming unit. Fourdriniers can be designed for very large ranges in drainage capacity. In this way there is high flexibility in using different consistencies for different drainage characteristics of various furnishes and for desired end results of the sheet. For instance, for the top ply, a low consistency can be used for a good formation and a smooth surface.

Different furnishes for each ply can be used in a multi-ply machine. For best smoothness, hardwood kraft may be used for top liner while high-yield pulp or recycled furnish is used in the middle layer. Separate whitewater systems can easily be used in multifourdrinier machines. This means a savings when bleached pulp is used for top liner. It also prevents contamination of outer plies with wax or "stickies" when using recycled furnish in the middle layer.

The multifourdrinier concept is by no means a new idea. For more than 20 years, machines in Europe have been making multi-ply board with several fourdriniers. Their use, however, was limited to slow-running boxboard machines. With the changing requirements of the containerboard maker, multifourdrinier containerboard machines are now in operation.

Replacing a secondary headbox with a minifourdrinier can immediately lead to considerable improvements. Figure 2 shows a wet end of a Swedish machine, which makes two-ply liquid packaging board and has been in operation since 1976.

Machines with three or four fourdriniers also exist. Figure 3 shows a typical wet end of such a machine. This machine is for SAPPI Ltd. of South Africa and it will produce liquid packaging and kraft linerboard at an ultimate production rate of 990 tpd. The wire width is 295 in. (7.5 m). In order from bottom to top, the plies are produced with a base fourdrinier, an On-Top-Wire XC (extra capacity), and an On-Top-Wire. Machines of this type have already run at speeds of more than 1,700 fpm. Several multifourdrinier machines will come onstream in the next few years in several countries (Table 3).

**MULTI-PLY FORMING SOLUTIONS.** One of the potential problems that has previously limited the use of multifourdrinier machines is the ply bond. The ply bond is affected by the plies' moisture at the point of couching and by the amount of fines at the surface of the sheets. The correct moisture range has been thoroughly investigated and is now well under control.

The couching technique is simple. The couch roll is a drilled roll with a large, open area. The point of couching is between a table roll and a suction box, which follows the couching point. The positions of the couch roll

*FIGURE 2:* **Swedish machine making two-ply liquid packaging board.**

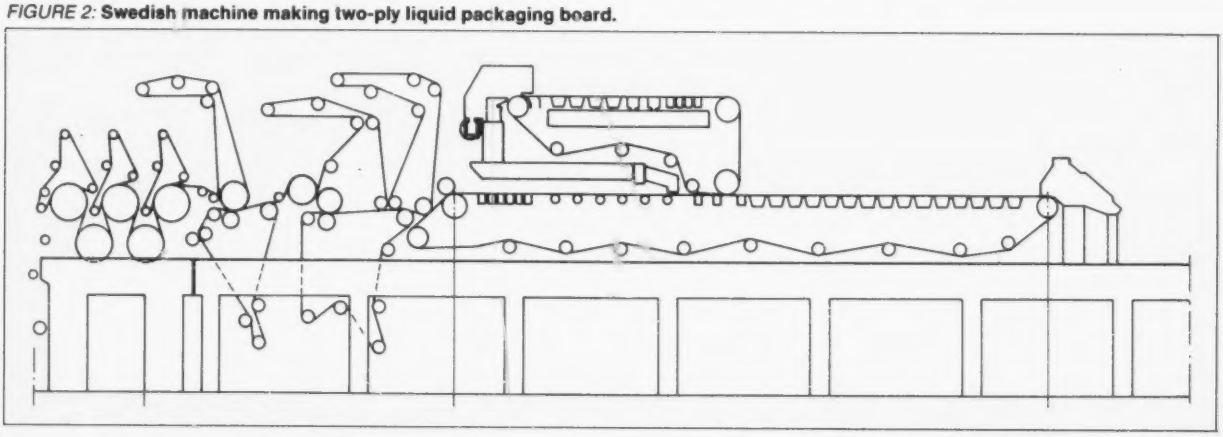
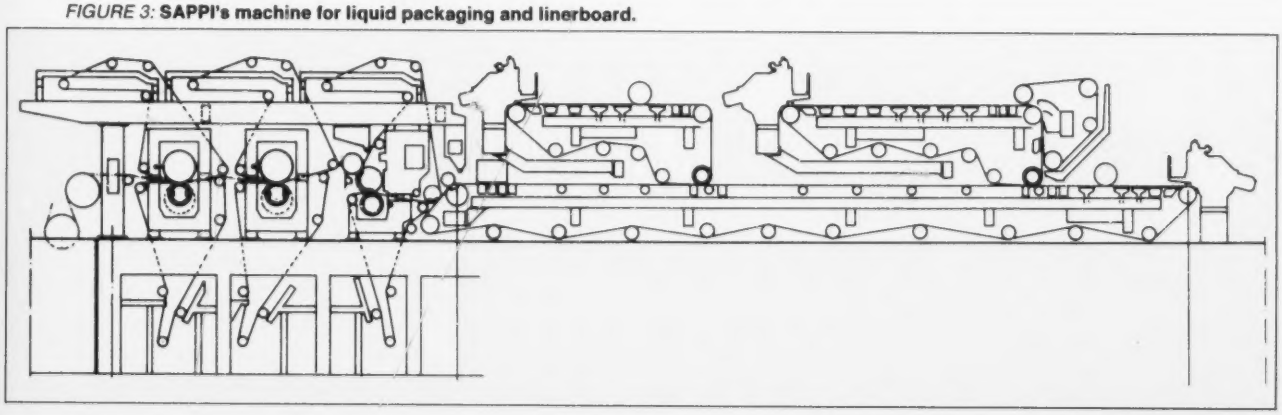


*FIGURE 3:* **SAPPI's machine for liquid packaging and linerboard.**



and the following inside wire roll must be adjustable. Modern electric-drive systems keep the speeds of the different wires identical.

In order to make use of the fines in the sheet, it is not advisable to couch two wire-sides together. A preferred location for a twin-wire former, such as the On-Top-Wire XC, is after the base fourdrinier headbox. This position allows more flexibility in moisture control before the couching point. Retention chemicals can also be used for the control of fines.

One common way to adjust ply bond is with refining. Increased refining gives a higher ply bond, but in certain cases it may decrease the board machine's production.

To secure ply bond in all conditions, many board makers have installed starch showers at the couching points. A typical amount of starch used per application is about 6 lb/ton of paper at a consistency of 2% to 3%.

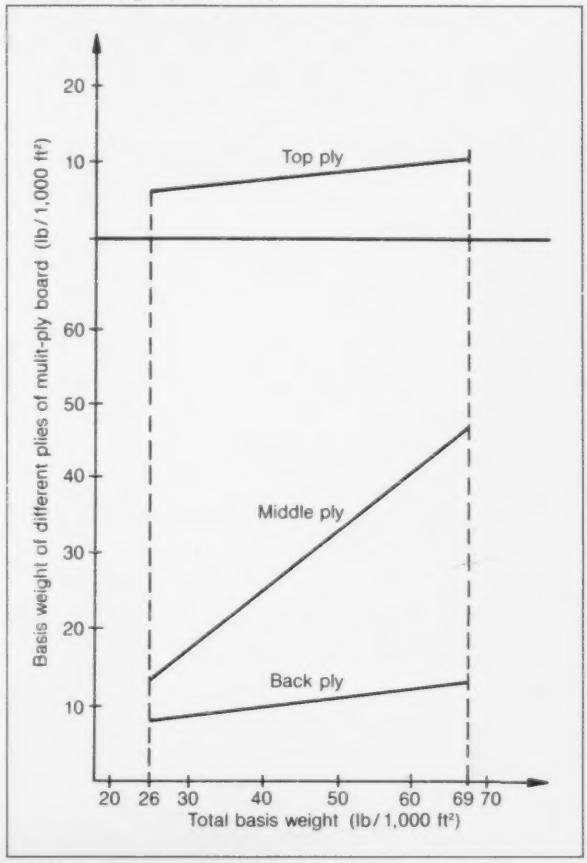
Because the outer plies often use more expensive furnish—it may be bleached, more refined, etc.—it is common to hold the basis weight of the top and bottom liner constant and vary the middle layer according to the total basis weight (Figure 4). This may cause some problems in designing headboxes as the middle-layer headbox is designed for a nearly constant flow, whereas the headboxes for outer layers will run at constant basis weight throughout the entire speed range and vary the fiber flow accordingly. Great attention must be paid not only to the headbox design, but also to the design of inlet piping, screens, pumps, etc. In sum, attention must be paid to the complete short circulation system.

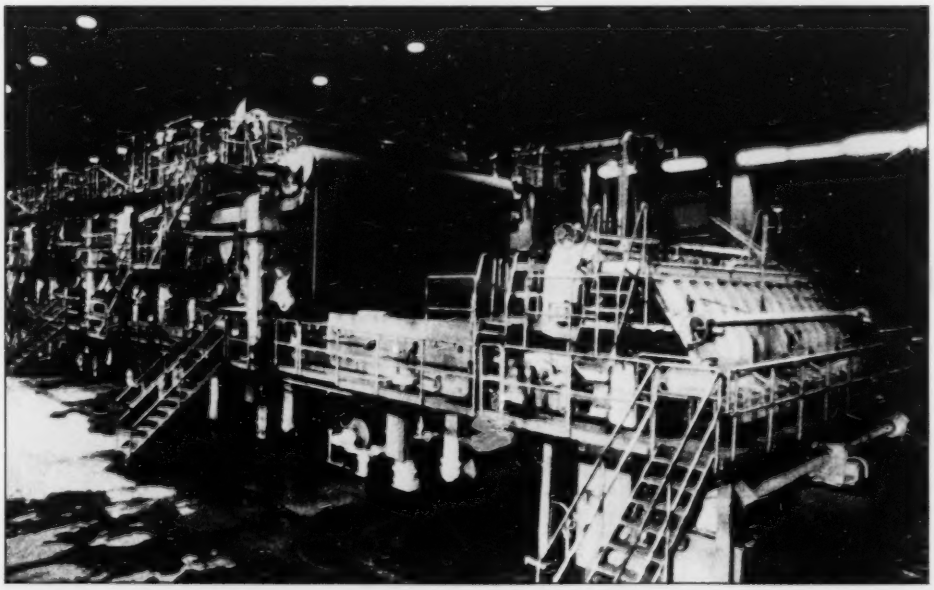
Modern process control systems allow automatic control of a multi-ply board machine. The control system is used for controlling the uniformity of the sheet, and it can also be used to help in startups, grade changes, etc.

**CONCLUSION.** Multifourdrinier machines enhance most of the qualities that modern trends in board making require. Any number of plies can be formed separately using different furnishes if necessary. Fourdrinier forming gives the container the highest top-to-bottom compressive strength and the best surface smoothness.

The ply bond is controlled by refining or adding starch with showers between the plies. Modern process control systems can help in the operation of a combination of multiformer machines, but the operation and maintenance of individual fourdriniers remain the same. Good maintenance of the equipment and well-trained personnel are still the most important factors in multifourdrinier papermaking. ■

*FIGURE 4:* **Basis weight of different plies of multi-ply board vs total basis weight (lb/1,000 ft²).**



**Liquid packaging board machine at ASSI, Frövifors Bruk AB, Sweden.**